R E P O R T R E S U M E S

ED 003 472 24

CONCEPT LEARNING AND PETENTION IN A SIMULATED CLASSROOM SITUATION.

BY- SEMLER, IRA J.
CEDAR RAPIDS COMMUNITY SCHOOL DISTRICT, IOWA

REPORT NUMBER CRP-S-225 PUB DATE 65
EDRS PRICE MF-$0.18 HC-$2.44 61P.

DESCRIPTORS- CONCEPT FORMATION, *CONCEPT TEACHING, *LEARNING THEORIES, *TEACHING MACHINES, TEACHING PROCEDURES, *TEACHING TECHNIQUES, GRADE 3, SIMULATION, CEDAR RAPIDS, IOWA

THE OBJECTIVE OF THIS STUDY WAS TO DETERMINE HOW MUCH IS LEARNED AND RETAINED BY CHILDREN WHO OBSERVE THE PERFORMANCE OF ANOTHER CHILD ON A TASK INVOLVING CONCEPT LEARNING. SUBJECTS FOR THE STUDY WERE THIRD-GRADE CHILDREN ASSIGNED TO SAME SEX GROUPS OF THREE. TWO CHILDREN (1 AND 2) OBSERVED WHILE THE THIRD CHILD (S1) USED AN ELECTRONICALLY CONTROLLED TEACHING DEVICE TO LEARN A CONCEPT. THE LEARNING ACHIEVED BY 1 WAS TESTED IMMEDIATELY AFTER OBSERVING S1, AND ALL THREE STUDENTS RETURNED 24 HOURS LATER TO BE TESTED INDIVIDUALLY FOR RETENTION USING A RELEARNING PROCEDURE. RESULTS OF THE STUDY SHOWED THAT CONCEPT LEARNING BY THE OBSERVING CHILD (1) WAS SIGNIFICANTLY SUPERIOR TO THE LEARNING OF THE FIRST PERFORMER (S1). THE AMOUNT GAINED BY THE OBSERVERS WAS APPROXIMATELY 22 PERCENT OVER THAT OF THE PERFORMERS. NEITHER SEX NOR IQ LEVEL WERE SIGNIFICANTLY RELATED TO THE SUPERIOR LEARNING ACHIEVED BY THE OBSERVERS. (AL)

ED003472

U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
Office of Education
This document has been reproduced exactly as received from the person or organization originating it. Points of view or opinions stated do not necessarily represent official Office of Education position or policy.

CONCEPT LEARNING AND RETENTION IN A SIMULATED CLASSROOM SITUATION

COOPERATIVE RESEARCH PROJECT NO. S-225

IRA J. SEMLER

CEDAR RAPIDS COMMUNITY SCHOOL DISTRICT, IOWA

1965

CONCEPT LEARNING AND RETENTION IN A SIMULATED CLASSROOM SITUATION

Cooperative Research Project No. S-225

Ira J. Semler

Cedar Rapids Community School District, Iowa

1965

The research reported herein was supported by the Cooperative Research Program of the Office of Education, U.S. Department of Health, Education, and Welfare.

ACKNOWLEDGMENTS

This study was made possible through the cooperation of the Research Center of the Cedar Rapids Community School District, Iowa, and the State Department of Public Instruction, Des Moines, Iowa. The support of Dr. Arnold Salisbury, Superintendent, Cedar Rapids Community School District, and Mr. Paul F. Johnston, Superintendent, State Department of Public Instruction, is gratefully acknowledged. Special acknowledgment goes to Mr. Arthur C. Anderson, Director of Instructional Research and Publications, Department of Public Instruction, who served as fiscal officer for the project.

The writer is indebted to Miss Catherine Eckstein, Principal of Cleveland Elementary School, Mr. Abraham Oglanian, Principal of Lincoln Elementary School, and Dr. Bryce Lindsay, Principal of Arthur Elementary School, for making children and research rooms available and smoothing the way for data gathering.

Mr. Terry F. Lehnis, graduate student in Counseling Psychology, Department of Psychology, State University of Iowa, Iowa City, Iowa, served as research assistant and provided invaluable help in gathering data and pushing the project through within the time available.

The writer also wishes to thank Mr. Darryl Phillips and Mr. Edward McGinty, Communications Engineering Company, Cedar Rapids, Iowa, for the design and construction of the electronic instrumentation.

Appreciation is expressed to Miss Diane DeLancey, Project Secretary, who took care of hundreds of details for the project and helped prepare the final report.

TABLE OF CONTENTS

ACKNOWLEDGMENTS..... 2

TABLE OF CONTENTS..... 3

TABLE OF TABLES AND FIGURE..... 4

PROBLEM..... 5

OBJECTIVES AND HYPOTHESES..... 7

RELATED RESEARCH..... 9
References..... 19

PROCEDURE..... 26
General Design..... 26
Relevant Subject Variables..... 27
Sample..... 27
Concept Formation Task..... 28
Stimulus Materials..... 30
Preliminary Try-out..... 31
Instrumentation..... 31
Task and Directions..... 32

ANALYSES OF DATA AND RESULTS..... 36
Subject Performance on Concept Formation and Retention Tasks..... 36
Comparison of S1 and O1 on Concept Formation..... 39
Comparison of Concept Formation and Retention for S1 and O1..... 41
Concept Retention: Comparison of S1, O1, and O2 under Relearning Procedures..... 43
Concept Retention: Analyses of Recall Scores..... 43
Speed of Response: Analyses of Latencies..... 46

CONCLUSIONS AND IMPLICATIONS..... 51

APPENDICES..... 55
Appendix A..... 55
Appendix B..... 56

TABLE OF TABLES AND FIGURE

Table 1: Mean Otis Quick Scoring Mental Ability Tests IQ and CA for Subjects by Triad Position, Sex, and IQ Level..... 29

Table 2: Mean Number of Correct Subject Responses out of 100 for Concept Formation and Retention by Triad Position, Sex, and IQ Level..... 37

Figure 1: Mean Number of Correct Concept Formation and Retention Responses in Trial Blocks of 10 as a Function of Triad Position..... 38

Table 3: Summary Analysis of Variance of Concept Formation Scores by Triad Position, Sex, and IQ Level..... 40

Table 4: Summary Analysis of Variance of Concept Formation and Retention Scores by Triad Position, Sex, and IQ Level..... 42

Table 5: Summary Analysis of Variance of Concept Retention Scores by Triad Position, Sex, and IQ Level..... 44

Table 6: Means, Standard Deviations, and Summary Analysis of Variance of Concept Formation Scores on Trial Block 10 as a Function of Triad Position..... 45

Table 7: Means, Standard Deviations, and Summary Analysis of Variance of Recall Scores on Trial Block 1 of Concept Retention as a Function of Triad Position..... 47

Table 8: Summary Analysis of Variance of Concept Formation Latencies by Triad Position, Sex, and IQ Level..... 48

Table 9: Summary Analysis of Variance of Concept Retention Latencies by Triad Position, Sex, and IQ Level..... 50

PROBLEM

There are many difficult and complex problems facing the investigator of classroom learning processes. The main difficulty is the lack of a comprehensive and well-defined theoretical structure for directing research effort. This means that creative research strategies must be devised in order to make careful observations of the educational process so that the results can be related to known empirical facts, already established relationships, or present theories.

A second major problem is the large number of complex and interacting variables which influence classroom learning. The designer of research in this area must first identify the relevant variables and somehow reduce the number to manageable proportions if clear results are to be obtained. The selection of a few relevant variables and an appropriate research strategy can provide meaningful knowledge about classroom learning processes.

The present investigation simulates an instructional procedure commonly observed in all classrooms at all age-grade levels and has a research background in the areas of concept formation and social learning theory. The teaching procedure to be simulated can be described briefly as the use of one or two children to demonstrate some new concept to the rest of the class. In this situation, the demonstration children are taught what to learn, how to learn it, and are given guidance until satisfactory learning is demonstrated while the rest of the class merely observes. The assumption implicit in this teaching situation is that the observing children have learned the concepts illustrated during the demonstration and are capable of demonstrating their learning by performing adequately on the same task. Certainly, the amount of conceptual information learned and retained by the demonstration children is different from the onlookers, however, seldom are more than gross estimates of observational learning obtained in the classroom.

The concept learning and retention by children who act as observers in simulation of the classroom procedure described above is the concern of this research. Information about the amount of conceptual information learned and retained through observation should be of general value to the educator since most classroom learning is of this type. Of importance also, is the research design which forms a useful strategy for studying complex classroom conditions in a simpler fashion. Also, because the variables are studied with simulation procedures the results are generalizable within the boundaries established by the experimental conditions.

OBJECTIVES AND HYPOTHESES

The general objective was to study the observational learning of third grade children using a miniature simulated classroom. The simulation procedure involved triads of three same sex subjects two of whom (O1, O2) observed a third (S1) learn a concept from an electronically controlled teaching device before performing the same task themselves. The major research question was concerned with the amount of concept learning and retention of the observers O1 and O2 in comparison with the baseline performance of S1. Stated generally, the research question was: How much is learned and retained by children who observe the performance of another child on a task involving concept learning?

The dependent variable was performance on a concept formation and retention task. The major independent variable under investigation was triad position, i.e., the performance of O1 compared with S1 on concept formation and the performance of O1 and O2 compared with S1 on a 24 hour concept retention test. In addition, subject sex and intelligence level were controlled experimentally since they are variables commonly believed to be relevant to classroom learning.

The hypotheses inherent in the research design (see General Design in PROCEDURES below) were tested by the appropriate statistical analyses. Specifically, superior concept formation in terms of average performance was predicted for O1 in comparison with S1 since O1 had the advantage of observational learning before being tested. It should be noted that O2 was used only for the 24 hour retention test and not for concept formation comparisons. The predicted order of mean performance on the concept retention test as a function of triad position was O1 > S1 > O2.

Hypotheses regarding the influence of subject variables were not made since the research emphasis was on observational learning, however, sex and IQ level were used as controls because of their educational significance and to provide empirical information about their effect on concept formation and retention.

The influence of the experimental and control variables on the speed of response (latencies) to the stimulus materials used in the concept formation and retention tasks was not hypothesized but the results will provide performance speed estimates for further concept formation experiments of this type.

RELATED RESEARCH

Two areas of psychological research provided the background of theoretical and empirical findings for this project. The first is the general area of concept formation and ranges from the early work of Hull (1920) to the concept acquisition studies of Heidbreder (1946a, 1946b, 1947) as well as a variety of work reported by child developmentalists interested in age related concepts (Ames, 1946; Deutsche, 1937; Long, 1940; Welch, 1939a). Much of the early work on concept formation has been outlined by Vinacke (1951) and Kendler (1961) has reviewed some of the more recent research. The history of research since Vinacke's 1951 report is not only varied but extensive. The most recent research on the relationship of discrimination learning, associative learning, and verbal learning to concept formation has been reported in a monograph on intellective processes (Wright & Kagan, 1963), however, a comprehensive and up-to-date summary is long overdue. No attempt will be made here to provide an extensive summary but rather to select experimental research articles which are representative of the area of concept formation. Research in the area of classroom or simulated classroom processes is not as extensive in range or depth as in the concept formation area, however, some research can be pulled together within a social-psychological framework and applied to the investigation of observational learning in children. Miller & Dollard's (1941) work suggests the lawful relationships among antecedents to social learning and imitation. Some fairly recent work by Rosenblith (1959, 1961) and Wilson (1958) with preschool and kindergarten children further explicates the power of social learning through observation. Recent work by Rosenbaum & Tucker (1962) has approached the relationship between the observer and the model with a more powerful theoretical design.

The application of what is known about the learning process through investigations of classroom learning proceeds at a slow pace. It is in the interest of education to make significant research tests which are feasible (Semler & Iscoe, 1963) and to generate empirical results which may be immediately useful in analyzing classroom learning, however, such research should be theoretically

sound and based upon previous empirical findings.

Concept Formation

The definition of concept formation, like many definitions which are used to explicate areas in the behavioral sciences, is somewhat fuzzy due to a multiplicity of meaning. However, the definition of concept formation most generally accepted is "the acquisition or utilization, or both, of a common response to dissimilar stimuli" (Kendler, 1961, p. 447). Kendler also notes that concept formation, concept attainment, and concept learning are often used interchangeably even though they represent different processes because the procedures which provide operational definitions overlap or are not discriminably different. Where conceptual processes are very clearly defined, the experimenter may prefer a modification of the above definition (Hunt, 1962).

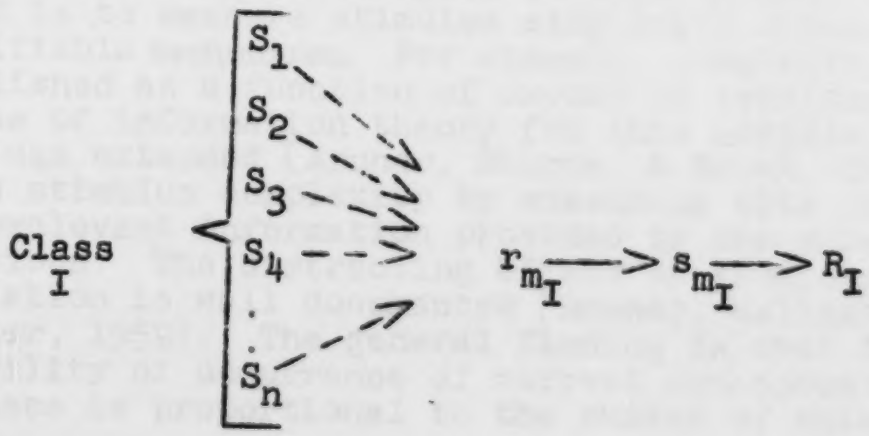
Experimental approaches to the study of concept formation have been addressed to investigations of the characteristics common to concepts. For one group of investigators common characteristics are identical elements which tag each member of a concept class. Another group of investigators use "relationship among parts" as the common characteristics of class membership. As Osgood (1953, p.666) notes, probably "the only essential common characteristic is that a group of discrete situations be associated through learning with the same mediating or symbolic reaction".

The classic study of Hull (1920) assumed that concepts are formed through abstracting common elements and was a behavioristic answer to pre-scientific work which attempted to analyze concept formation through introspective processes. His aim was to specify the quantitative relationship between stimulus and response variables. The process of generalization-abstraction defined concept formation for Hull and involved the discrimination of a particular element common to a variety of stimuli. He attempted to carry his definition over into a rigorous experimental procedure and had subjects associate a particular nonsense syllable with a particular nonchanging element of a changing stimulus pattern, i.e., a common radical imbedded in a series of Chinese figures. The results showed that once this association had been made it could be transferred to a new stimulus pattern containing the element. It was found that subjects could form the concept without being able to define the guiding concept. Hull's research in concept formation provided two significant contributions to behavioral science. First, he provided an experimental

procedure for studying thinking which was rigorous and well-defined and did not depend upon introspection procedures. Second, he provided an analysis of concept formation in terms of observable stimulus-response relationships without depending on mediating processes.

The discrimination-abstraction theory of Hull was only slightly modified by Skinner (1953, 1957) to include reinforcement principles to shape conceptual behavior. Restle's (1955) account of discrimination learning was extended by statistical learning theory as exemplified by Bourne & Restle (1959) to include the conditioning of relevant cues through rewards and adaptation to irrelevant cues through nonreward. Basically, this theory assumes that rate of concept learning is a function of the proportion of relevant cues and the probability that a cue is present at the time of reinforcement. Concept identification is only a slight complication of discrimination learning according to Bourne & Restle (1959) and has been useful in confirming a number of predictions in this area. Harlow (1959) also gives discrimination a central role in learning set which he considers basic to concept formation. The discrimination process applied to learning set according to Harlow is nothing more than the elimination of responses and response tendencies to a particular learning situation. Inhibition, not acquisition, is central to this process.

Much contemporary concept formation research is focused on the study of higher mental processes, i.e., the internal process which mediates between stimulus and response. This line of research presumes that similar responses (concepts) to different stimuli are acquired. How else can one explain common responses to stimuli which have no overt physical similarities? This approach is associated with Cofer & Foley (1942), Goss (1958), Kendler & D'Amato (1955), Miller & Dollard (1941), Osgood (1957), and others. The basic mediational model suggested by the learning paradigm could be schematized as follows:



Reed's (1946a, 1946b, 1946c) research exemplifies the mediational learning paradigm, although, he attributed facility in concept learning and retention to such factors as motivation and logical relations. In this study, subjects learned to associate a spoken nonsense syllable to a specific class of English words such as colors, animals, vegetables, and so on. Thus, once the mediating concept (correct nonsense syllable) was discovered the inclusion of new class members required little effort.

It should be noted that Hull (1930) later conceived of the "pure stimulus act" which was a cue-producing response with concept formation due to the acquisition of a common mediating response which was the result of learned stimulus equivalents. This type of analysis emphasized the significance of previously learned responses in concept formation situations. These learned responses can generate stimuli which interact or compete with environmental stimuli to control overt behavior. Analyses of this sort should be highly palatable to educators since they offer a more precise way of getting at important behavioral determinants.

Many contemporary psychological studies of concept formation show the influence of complex electronic information-processing systems (Newell, Shaw, & Simon, 1958), symbolic logic and set theory (Hunt, 1962), and servo-mechanisms (Miller, Galanter, & Pribram, 1960). Inevitably, theories of higher mental processes derived from electronic data processing systems emphasize the process and not overt behavior.

A variety of stimulus factors can be specified as accessible to experimentation on concept formation studies. The easiest stimulus attribute to be studied is concept simplicity. This can be measured by determining the difficulty with which a concept is acquired, i.e., the response made to it. Heidbreder's (1946a, 1946b, 1947) experiments are good examples of this method. The other method is to measure stimulus simplicity directly by quantifiable techniques. For example, complexity could be established as a function of amount of irrelevant information. The use of information theory for this purpose (Hovland, 1952) was extended (Archer, Bourne, & Brown, 1955) to assess stimulus complexity by measuring bits of relevant and irrelevant information provided in the experimental conditions. The distracting effect of irrelevant concept stimulation is well documented (Bruner, Wallach, & Galanter, 1959). The general finding is that the probability of occurrence of correct conceptual verbal responses is proportional to the number of antecedent

positive instances.

The additivity of stimulus complexity and stimulus redundancy is theorized by Bourne & Restle (1959). Findings show that redundant irrelevant information interferes with performance much less than nonredundant irrelevant information. Haygood & Bourne (1956) have outlined stimulus mapping procedures on a binary response system. They have also provided a comprehensive set of conceptual rules in symbolic logic as well as verbal terms for describing partitions of a stimulus population with two focal attributes.

Motivational factors in concept formation studies have not been examined extensively and probably future research will concentrate on the effect of differential drive states on mediating responses in general and not on concept mediating responses in particular. Some work has been done on scheduling of reward and feedback (Bourne & Pendleton, 1958) which offers the possibility of establishing measures of concept formation efficiency.

The study of reversal and nonreversal shifts in concept formation has been extensively covered (Lachman & Sanders, 1963; Isaacs & Duncan, 1962; Gormezano & Abraham, 1961; Kendler & Kendler, 1959; Kendler & D'Amato, 1955) and form important evidence regarding the functional dominance of relevant mediating responses.

Concept formation as a function of number of positive and negative instances has been thoroughly investigated (Sechrest & Wallace, 1962; Mayzner & Tresselt, 1962; Mayzner, 1962; Shore & Sechrest, 1961; Hovland & Weiss, 1953). Information theory has been used by Hovland & Weiss (1953) to equate amount of information transmitted by positive and negative instances and found that all positive instances facilitate concept formation better than all negative instances. The factor of memory in the acquisition of concepts is of significance since failure to remember positive and negative instances early in concept learning sequences contributes most to concept formation failure. The study of this factor using computer simulation techniques seems appropriate since unlimited memory capacity is available.

The types of responses used in concept formation studies have ranged from simple motor responses, such as lever pulling or button pushing, to verbal responses of varying degress of complexity, such as simple yes-no answers or complex introspective reports. The role of

language is extremely important in concept formation since verbal materials readily generate conceptualization. The relationship between concept formation and paired-associate learning is quite clear and emphasizes the role of language in the cognitive processes. Underwood & Richardson (1956) used a word association technique to establish a habit family hierarchy of verbal responses to a list of 213 words. Associations were restricted to sense impressions. This list served as a basis for research in concept formation studies especially in relationship to paired-associate learning.

Much of the early research on concept formation has been outlined by Vinacke (1951) and should be of interest to developmental and educational psychologists. Vinacke's purpose was to provide a broader basis for understanding concept formation than had been evident in previous experimental studies. While this review is now out of date, it none-the-less gives a good overview of important early developmental work. Early child developmentalists were interested in specifying concept attainments at various chronological age levels with descriptive studies of concept gradations from simple to complex or concept orders from lower to higher (Long & Welch, 1942; Welch, 1940; Welch & Long, 1940a, 1940b; Wenzel & Flurry, 1948). The findings were descriptive, for example, triangularity can be established below 2 years of age (Gellermann, 1933a, 1933b; Munn & Steining, 1931), roundedness at 3 years of age (Long, 1940), size as early as the 14th month (Hicks & Stewart, 1930; Thrum, 1935; Welch, 1938, 1939a, 1939b, 1939c), time (Ames, 1946; Friedman, 1944a, 1944b), cause and effect relationships (Lacey & Dallenbach, 1939), social concepts (Ordan, 1945), plus many other concept dimensions both simple and complex. Patterns or sequences of development of conceptual abilities have also been studied (Reichard, Schneider, & Rapaport, 1944; Wenzel & Flurry, 1948). While such studies are interesting, they are not particularly useful in experimental analyses of conceptual behavior and too much dependent upon the whim of the experimenter.

The noteworthy work of Jean Piaget is neglected here because of its non-experimental emphasis, however, a comprehensive report of a conference on intellective development pays particular attention to this work and is worthwhile reading (Kessen & Kuhlman, 1962).

Observational Learning

The fact that classroom learning is inextricably bound to small-group social-psychological processes has not been investigated thoroughly and yet the fact that these processes influence classroom learning has practical and theoretical importance to education. That children learn vicariously is commonly accepted and deserves more emphasis in educational research effort. It should be noted that much theoretical research has come from the psychology laboratory but the application of this work to problems in education has not been extensive. Any thorough analysis of classroom behavior will show that copying, imitation, and learning by observation are characteristic of the educational process. A selected set of research which has theoretical and applied implications will be reviewed in order to emphasize the useful notions already developed in this area.

A brief description of the basic model of observational learning is in order to give meaning to the research review which follows. The conventional research technique involves a subject who observes a performer (model) execute some task, usually a learning task of some sort, before performing on the same task. An assessment is then made of differences between the observer and the performer to obtain comparative estimates of amount learned. A large number of significant social-psychological variables can be studied with this technique under highly controlled laboratory conditions.

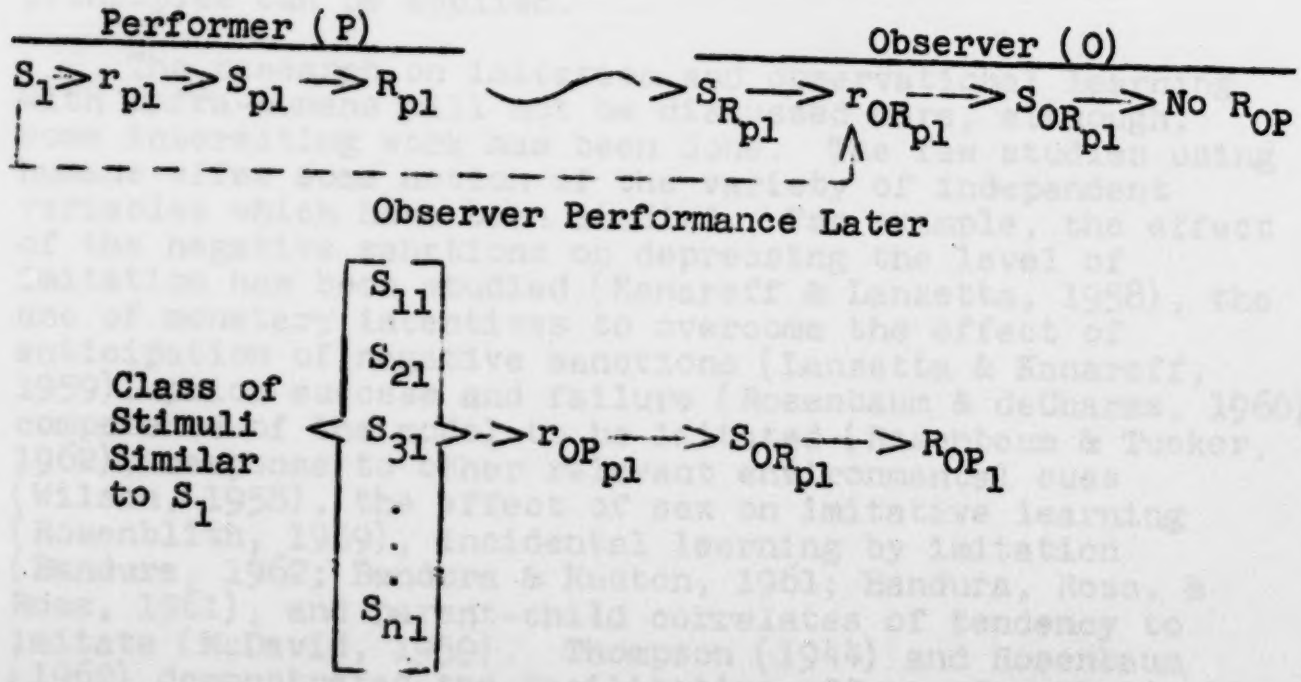
The classic work in the area of social learning and imitation was done by Miller & Dollard (1941). Their effort was directed toward an application of reinforcement learning principles to the development of a social learning theory. The application of drive, cue, response, and reinforcement to examples of everyday social living is most instructive and worth reading for anyone interested in getting a deeper understanding of social processes.

A great deal of the laboratory work suggests that the behavior of the performer is important but may be an irrelevant event. For example, instead of a human performer an apparatus is used to feed information, true or false, to the observing subject. This laboratory procedure has been used by Kanareff & Lanzetta (1958) and Rosenbaum & Tucker (1962). Thus, the experimental apparatus is designed to furnish cues and reinforcing conditions so that the observer can obtain knowledge of the requirements of performance. This technique suggests that the variables which affect discrimination learning are also related to observational or imitative learning. It can be seen from

the basic model of observational learning described above that the time factor is important and, in fact, observational learning is clearly a case of delayed learning. Thus, theoretical accounts of variables resulting from delayed learning such as acquired distinctiveness of cues, motivation, partial reinforcement, extinction, and forgetting can be applied to the behavior of the observer. In other words, the entire sequence of stimulus, response, and reinforcement contingencies which is in the observer is actually a set of responses to the behavior of the performer and operate as if the observer had been responding (deCharms & Rosenbaum, 1960).

Behavior modification by observation can be demonstrated by exposing a subject to a specific stimulus situation (usually involving another subject who performs or an apparatus which produces artificial data), obtaining responses of the observing subject to the same task, and checking for modification of the response repertory. It must be demonstrated that the observer's repertory has been modified in the same way as the performer. A schematic of this process could be diagrammed as follows:

Observational Learning



The performer (P) responds to any stimulus S_1 and the observer (O) responds to P's response R_{P1} but only in a covert way since no response can be made by the observer (No R_{OP1}). Later when the observer is tested for behavioral

modification in the direction of the performer, any stimulus (S_{n1}) which is similar to S_1 through stimulus generalization elicits $r_{OR_{p1}}$ mediating a response which is similar to that of the performer (R_{OP1}) during observational learning. This oversimplification of the observation process depends upon prior reinforcement for imitation and is dependent upon reinforcement at some stage of the sequence of observation, delay, mediation, and overt observer response. The mediational response is derived from observation of one response from the performer's repertory and based on stimulus generalization relationships. Thus, a variety of stimuli might evoke these mediating responses which in turn elicit the overt response. Continued observation of the performer increases the probability of the overt response. Osgood (1956) and Lazowick (1955) view this process as representing identification between parent and child and has obvious application to classroom dynamics involving observational learning.

Classical conditioning may well play a part in the process (Berger, 1962; Mowrer, 1960), however, a good deal of theoretical work is necessary before conditioning principles can be applied.

The research on imitation and observational learning with infra-humans will not be discussed here, although, some interesting work has been done. The few studies using humans offer some notion of the variety of independent variables which have been studied. For example, the effect of the negative sanctions on depressing the level of imitation has been studied (Kanareff & Lanzetta, 1958), the use of monetary incentives to overcome the effect of anticipation of negative sanctions (Lanzetta & Kanareff, 1959), prior success and failure (Rosenbaum & deCharms, 1960), competence of the model to be imitated (Rosenbaum & Tucker, 1962), response to other relevant environmental cues (Wilson, 1958), the effect of sex on imitative learning (Rosenblith, 1959), incidental learning by imitation (Bandura, 1962; Bandura & Huston, 1961; Bandura, Ross, & Ross, 1961), and parent-child correlates of tendency to imitate (McDavid, 1959). Thompson (1944) and Rosenbaum (1962) demonstrated the facilitative effect of verbalization during observing on observational learning in children. Lewis & Duncan (1958) showed that human observers will respond during extinction in a manner consistent with the extinction of the performer following partial reinforcement. Further, there is good evidence for the clinical use of

observational learning to reduce hostility (Rosenbaum & deCharms, 1960) which indicates the potential usefulness of research results in studies of classroom learning.

The research on observational learning is limited, however, there is little doubt that sufficient theory has been developed and empirical tests made to suggest that the application of this particular social-psychological process is vital to a better understanding of classroom learning.

The application of what is known about the learning process, particularly concept formation and observational learning, to investigations of classroom learning proceeds at a slow pace. It is in the interest of education to make use of theoretical formulations where they exist and to make research tests of these theories. It is of especial importance to generate empirical results by appropriate methodologies which may be immediately useful in analyzing classroom learning. Such research should also provide fruitful approaches to the further study of the educational process.

REFERENCES

Ames, L.B. The development of the sense of time in the young child. J. genet. Psychol., 1946, 68, 97-125.

Archer, E.J., Bourne, L.E., & Brown, F.G. Concept identification as a function of irrelevant information and instructions. J. exp. Psychol., 1955, 49, 153-163.

Bandura, A. Social learning through imitation. In M.R. Jones (Ed.) Nebraska Symposium on Motivation, Univ. of Nebraska Press, 1962.

Bandura, A., & Huston, A.O. Identification as a process of incidental learning. J. abnorm. soc. Psychol., 1961, 63, 311-318.

Bandura, A., Ross, D., & Ross, S.A. Transmission of aggression through imitation of aggressive models. J. abnorm. soc. Psychol., 1961, 63, 575-582.

Berger, S.M. Conditioning through vicarious instigation. Psychol. Rev., 1962, 69, 450-466.

Bourne, L.E., Jr., & Pendleton, R.B. Concept identification as a function of completeness and probability of information feedback. J. exp. Psychol., 1958, 56, 413-419.

Bourne, L.E., Jr., & Restle, F. Mathematical theory of concept identification. Psychol. Rev., 1959, 66, 278-296.

Bruner, J.S., Wallach, M.A., & Galanter, E.H. The identification of recurrent regularity. Amer. J. Psychol., 1959, 72, 200-209.

Cofer, C.N., & Foley, J.P., Jr. Mediated generalization and the interpretation of verbal behavior: I. Prolegomena. Psychol. Rev., 1942, 49, 513-540.

de Charms, R., & Rosenbaum, M.E. The problem of vicarious experience. In D. Willner (Ed.). Decisions, Values, and Groups. Vol. I, New York: Pergamon, 1960.

Deutsche, J.M. The development of children's concepts of causal relations. Univ. Minnesota, Inst. Child Welf. Monogr. Series. Minneapolis: Univ. Minnesota Press, 1937.

Friedman, K.C. Time concepts of elementary school children. Elem. Sch. J., 1944, 44, 337-342. (a)

Friedman, K.C. Time concepts of junior and senior high school pupils and of adults. Sch. Rev., 1944, 52, 233-238. (b)

Gellermann, L.W. Form discrimination in chimpanzees and two-year-old children. I. Form (triangularity) per se. J. genet. Psychol., 1933, 42, 3-27. (a)

Gellermann, L.W. II. Form vs. background. J. genet. Psychol., 1933, 42, 28-50. (b)

Gormezano, I., & Abraham, F.D. Intermittent reinforcement, nonreversal shifts, and neutralizing in concept formation. J. exp. Psychol., 1961, 61, 1-6.

Goss, A.E. Mediating responses and concept formation. Paper read at Symposium on Mediating Processes in Transfer, Amer. Psychol. Ass., Washington, D.C., 1958.

Harlow, H.F. Learning set and error factor theory. In S. Koch (Ed.), Psychology: A study of a science. Volume II: General systematic formulation, learning and special processes. New York: McGraw-Hill Book Co., 1959. Pp. 492-537.

Haygood, R.C., & Bourne, L.E., Jr. Attribute--and rule-learning aspects of conceptual behavior. Psychol. Rev., 1965, 72, 175-195.

Heidbreder, E. The attainment of concepts: I. Terminology and methodology. J. gen. Psychol., 1946, 35, 173-189. (a)

Heidbreder, E. The attainment of concepts: II. The problem. J. gen. Psychol., 1946, 35, 191-223. (b)

Heidbreder, E. The attainment of concepts: III. The process. J. Psychol., 1947, 24, 93-138.

Hovland, C.I. A "communication analysis" of concept learning. Psychol. Rev., 1952, 59, 461-472.

Hovland, C.I., & Weiss, W. Transmission of information concerning concepts through positive and negative instances. J. exp. Psychol., 1953, 45, 175-182.

Hull, C.L. Quantitative aspects of the evolution of concepts. Psychol. Monogr., 1920, No. 123.

Hull, C.L. Knowledge and purpose as habit mechanisms. Psychol. Rev., 1930, 37, 511-525.

Hunt, E.B. Concept learning: An information processing problem. New York: John Wiley & Sons, Inc., 1962.

Isaacs, I.D., & Duncan, C.P. Reversal and nonreversal shifts within and between dimensions in concept formation. J. exp. Psychol., 1962, 64, 580-585.

Kanareff, Vera T., & Lanzetta, J.T. The acquisition of imitative and opposition responses under two conditions of instruction induced set. J. exp. Psychol., 1958, 56, 516-528.

Kendler, H.H., & D'Amato, M.F. A comparison of reversal shifts and nonreversal shifts in human concept formation behavior. J. exp. Psychol., 1955, 49, 165-174.

Kendler, T.S., & Kendler, H.H. Reversal and nonreversal shifts in kindergarten children. J. exp. Psychol., 1959, 58, 56-60.

Kendler, T.S. Concept formation. Annu. Rev. Psychol., 1961, 12, 447-472.

Kessen, W., & Kuhlman, Clementina. Thought in the young child. Child Develpm. Monogr., 1962, 27, Serial No. 83, (No. 2).

Lacey, J.I., & Dallenbach, K.M. Acquisition by children of the cause-effect relationship. Amer. J. Psychol., 1939, 52, 103-110.

Lachman, R., & Sanders, J.A. Concept shifts and verbal behavior. J. exp. Psychol., 1963, 65, 22-29.

Lanzetta, J.T., & Kanareff, Vera T. The effects of a monetary reward on the acquisition of an imitative response. J. abnorm. soc. Psychol., 1959, 59, 120-127.

Lazowick, L. On the nature of identification. J. abnorm. soc. Psychol., 1955, 51, 175-183.

Lewis, D.J., & Duncan, C.P. Vicarious experience and partial reinforcement. J. abnorm. soc. Psychol., 1958, 57, 321-326.

Lindquist, E.F. Design and analysis of experiments in psychology and education. Boston: Houghton Mifflin, 1953.

Long, L. Conceptual relationships in children. The concept of roundness. J. genet. Psychol., 1940, 57, 289-315.

Long, L., & Welch, L. Influence of levels of abstractness on reasoning ability. J. Psychol., 1942, 13, 41-59.

Mayzner, M.S. Verbal concept attainment: A function of the number of positive and negative instances presented. J.exp. Psychol., 1962, 63, 314-319.

Mayzner, M.S., & Tresselt, M.E. Verbal concept attainment: A function of the number and strength of positive instances presented. J. Psychol., 1962, 53, 469-474.

McDavid, J.W. Imitative behavior in preschool children. Psychol. Monogr., 1959, 73, No. 16. (Whole No. 486).

Miller, G.A., Galanter, E., & Pribram, K.H. Plans and the structure of behavior. New York: Henry Holt & Co., 1960.

Miller, N.E., & Dollard, J. Social learning and imitation. New Haven: Yale Univ. Press, 1941.

Mowrer, O.H. Learning theory and the symbolic processes. New York: Wiley, 1960.

Munn, N.L., & Steining, B.R. The relative efficacy of form and background in a child's discrimination of visual patterns. J. genet. Psychol., 1931, 39, 73-90.

Munsell Teachers Demonstration Set. Munsell Color Co., Inc., 2441 N. Calvert, Baltimore, Maryland.

Newell, A., Shaw, J.C., & Simon, H.A. Elements of a theory of human problem solving. Psychol. Rev., 1958, 65, 151-166.

Ordan, H. Social concepts and the child mind. New York: King's Crown Press, 1945.

Osgood, C.E. Method and theory in experimental psychology. New York: Oxford University Press, 1953.

Osgood, C.E. Behavior theory and the social sciences. Behav. Sci., 1956, 1, 167-185.

Osgood, C.E. A behavioristic analysis of perception and language as cognitive phenomena. In Contemporary approaches to cognition. Cambridge: Harvard Univ. Press, 1957. Pp. 75-118.

Reed, H.B. Factors influencing the learning and retention of concepts: I. The influence of set. J. exp. Psychol., 1946, 36, 71-87. (a)

Reed, H.B. The learning and retention of concepts: II. The influence of lengths of series. III. The origin of concepts. J. exp. Psychol., 1946, 36, 166-179. (b)

Reed, H.B. The learning and retention of concepts: IV. The influence of complexity of the stimuli. J. exp. Psychol., 1946, 36, 252-261. (c)

Reichard, S., Schneider, M., & Rapaport, D. The development of concept formation in children. Amer. J. Orthopsychiat., 1944, 14, 156-162.

Restle, F.A. A theory of discrimination learning. Psychol. Rev., 1955, 62, 11-19.

Rosenbaum, M.E. The effect of direct and vicarious verbalization on retention. Child Develpm., 1962, 33, 103-110.

Rosenbaum, M.E., & deCharms, R. Direct and vicarious reduction of hostility. J. abnorm. soc. Psychol., 1960, 60, 105-111.

Rosenbaum, M.E., & Tucker, I.F. The competence of the model and the learning of imitation and non-imitation. J. exp. Psychol., 1962, 63, 183-190.

Rosenblith, Judy F. Learning by imitation in kindergarten children. Child Develpm., 1959, 30, 69-80.

Rosenblith, Judy F. Imitative color choices in kindergarten children. Child Develpm., 1961, 32, 211-223.

Sechrest, L., & Wallace, J. Assimilation and utilization of information in concept attainment under varying conditions of information presentation. J. educ. Psychol., 1962, 53, 157-164.

Semler, I.J., & Iscoe, I. A comparative and developmental study of the learning abilities of negro and white children under four conditions. J. educ. Psychol., 1963, 54, 38-44.

Shore, E., & Sechrest, L. Concept attainment as a function of number of positive instances presented. J. educ. Psychol., 1961, 52, 303-307.

Skinner, B.F. Science and human behavior. New York: The Macmillan Company, 1953.

Skinner, B.F. Verbal behavior. New York: Appleton-Century-Crofts, 1957.

Thompson, Louise M. The role of verbalization in learning from demonstrations. Unpublished doctoral dissertation. Yale Univer., 1944.

Thrum, M.E. The development of concepts of magnitude. Child Develpm., 1935, 6, 120-140.

Underwood, B.J., & Richardson, J. Some verbal materials for the study of concept formation. Psychol. Bull., 1956, 53, 84-95.

Vinacke, W.E. The investigation of concept formation. Psychol. Bull., 1951, 48, 1-31.

Welch, L. A preliminary study of the interaction of conflicting concepts of children between the ages of 3 and 5 years. Psychol. Rev., 1938, 2, 439-459.

Welch, L. The development of discrimination of form and area. J. Psychol., 1939, 7, 37-54. (a)

Welch, L. The development of size discrimination between the ages of 12 and 40 months. J. genet. Psychol., 1939, 55, 243-268. (b)

Welch, L. The span of generalization below the two-year-age level. J. genet. Psychol., 1939, 55, 269-297. (c)

Welch, L. A preliminary investigation of some aspects of the hierarchical development of concepts. J. gen. Psychol., 1940, 22, 359-378.

Welch, L., & Long, L. The higher structural phases of concept formation of children. J. Psychol., 1940, 9, 59-95. (a)

Welch, L., & Long, L. A further investigation of the higher structural phases of concept formation. J. Psychol., 1940, 10, 211-220. (b)

Wenzel, B.M., & Flurry, C. The sequential order of concept attainment. J. exp. Psychol., 1948, 38, 547-557.

Wilson, W.C. Imitation and the learning of incidental cues by pre-school children. Child Develpm., 1958, 29, 393-397.

Wright, J.C., & Kagan, J. Basic cognitive processes in children. Child Develpm. Monogr., 1963, 28, Serial No. 86 (No. 2).

PROCEDURE

General Design

This experiment involved the repeated measurement of triads of same sex children (S1, O1, O2) on a concept formation and concept retention task. Each triad simulated a classroom situation. The experimental variable manipulated was triad position. Thus, the S1 subject learned a concept on an electronic teaching device while subjects in the O1 and O2 position merely observed the performance of S1. S1 and O2 left the experimental setting immediately after S1's performance and O1 was tested for concept learning using the same experimental procedure. Twenty-four hours later each of the triad members were returned individually to the experimental setting and tested for concept retention using a relearning procedure. The general design may be schematized as follows:

Concept Formation			Concept Retention
S1----Learns Concept from Experimental Apparatus	----Stops at End of Task and Leaves Immediately		----Test of Concept Retention under Relearning Procedure 24 Hours Later
O1----Observes S1	----Learns Same Concept Immediately After S1		----Test of Concept Retention under Relearning Procedure 24 Hours Later
O2----Observes S1	----Leaves Immediately		----Test of Concept Retention under Relearning Procedure 24 Hours Later

The rationale for using a 24 hour retention test is based on the notion that the educational process often requires children to demonstrate their retention of what was learned the previous day. The effect of observational learning on this later performance is the point in question.

The dependent variable was performance on the concept formation and retention tasks while the independent variable of triad position was experimentally manipulated. Other relevant variables of less importance to the main purpose of the experiment are discussed below.

Relevant Subject Variables

A rational decision to control certain subject variables was based on those child characteristics which most educators feel are relevant to classroom learning. In this particular experiment, chronological age was controlled by selecting subjects from a single age-grade level.

The sex variable was handled by assigning an equal number of boys and girls to the appropriate cells in the design so that the variance associated with performance on the concept formation and retention tasks could be examined statistically.

The relationship between measured intelligence, particularly measurements taken by group intelligence tests, to performance on various types of concept formation tasks is not known. However, group intelligence tests are widely used by educators to provide estimates of classroom learning ability. Therefore, it was decided to experimentally control this source of variance by selecting same sex subject triads from three IQ levels based on local norms. Otis Quick Scoring Mental Ability Tests are given routinely in the Cedar Rapids Community School District at the third grade level and statistics based upon these data were used to form three IQ levels. The mean IQ of Cedar Rapids children was 107.1 with a σ of 12.8. Three IQ levels were constituted by marking off points at PR 33 (IQ = 101.8) and PR 66 (IQ = 112.3). Thus, IQ level was defined as high for scores of 113 and above, middle for scores between 102 and 112, and low for scores of 101 and below.

Sample

Three elementary schools representative of the Cedar Rapids School population were selected and Otis Intelligence Quotients for the third grade children in these schools were obtained from the school records. Three weeks before the first experimental session a letter was sent to the parents of all third grade children in these schools

explaining the research project and asking permission to let their child participate (see Appendix A). There was only one refusal out of the 200 letters which were sent out.

The children in each school were assigned to the appropriate cells of a sex X IQ level (2 X 3) matrix. Finally, three same sex subjects (triads) plus one alternate were selected from each matrix cell to provide a total sample of 90 children, 45 boys and 45 girls. Triad position (S1, O1, O2) was assigned randomly within each triad.

Table 1 presents the mean IQ and CA by triad position, sex, and IQ level for the third grade children who served as subjects in this experiment.

Concept Formation Task

Much of the experimental work on concept formation in children involves simple perceptual dimensions which have been learned early in life. It is not uncommon to find concept formation stimulus materials composed of values from dimensions such as shape, color, size, and position. Therefore, the concept formation task developed especially for this experiment was composed of three shapes (square, circle, triangle), six colors (red, blue, green, yellow, black, white), and size (small, large). It should be noted at the outset that all three shapes appeared on each stimulus presentation with the position of the three shapes varied randomly.

A relational concept from the color and shape dimensions, namely, red square, was chosen as the relevant concept, that is, the one to be learned. All other values on the dimensions used were irrelevant, that is, were not to be learned. While the task appears to be a difficult one due to the almost unlimited number of combinations due to the interaction of irrelevant values on the various stimulus dimensions, it was felt to be within the problem solving capabilities of third grade children. It was found out later that this assumption did not hold true for 100 percent of the subjects.

Table 1

Otis Quick Scoring Mental Ability Tests Mean IQ and Mean CA for Subjects by Triad Position, Sex, and IQ Level

Triad Position	Sex	IQ Level	N	IQ	CA[a]
S1	Boys	High	5	121.0	107.4
		Medium	5	107.0	106.6
		Low	5	93.2	106.8
	Girls	High	5	122.8	105.6
		Medium	5	107.8	107.6
		Low	5	95.8	107.4
O1	Boys	High	5	120.6	107.4
		Medium	5	109.2	106.8
		Low	5	96.8	107.8
	Girls	High	5	128.4	104.6
		Medium	5	109.2	105.4
		Low	5	98.4	106.8
O2	Boys	High	5	122.0	106.0
		Medium	5	104.0	107.0
		Low	5	96.4	111.4
	Girls	High	5	125.2	104.4
		Medium	5	104.6	107.2
		Low	5	94.8	102.8

[a]CA is in months.

A schedule of appearance of values within the size, color, and position dimensions for 100 successive stimulus presentations was determined by randomization procedures with the following restrictions.

1. Different colors for the three shapes on any single stimulus presentation.
2. Different colors for any single shape on any two successive stimulus presentations, excepting the relevant concept.
3. The relevant concept, red square, to appear randomly 50 percent of the time within each trial block of 10 stimulus presentations.

These restrictions were designed to reduce irrelevant concept learning due to chance color pattern or colored shape similarities (1 and 2 above) and increase positive instances of the relevant concept significantly above chance (3 above). The schedule of appearance of values appears in Appendix B.

Stimulus Materials

The stimulus materials were colored 35 mm. photographs of the 100 stimulus patterns established by the schedule of appearance of values in the Concept Formation Task section above. An 18 in. X 24 in. masonite frame (1/8 in.) was devised to hold 6 in. X 8 in. masonite rectangles in a three row by three column arrangement providing a total of nine positions which could be filled (see Appendix B for position code). Six 6 in. X 8 in. rectangles had a window-like opening cut from the center in one of three shapes in two sizes, namely, large square, small square, large circle, small circle, large triangle, and small triangle. The cut-out rectangles, extra blank rectangles, and the frame were painted an off-white color for photographing purposes. Six high quality Munsell color sheets in red, blue, green, yellow, black, and white were selected from the Munsell Teachers Demonstration Set (see REFERENCES in RELATED RESEARCH). Thus, any one of the 100 stimulus patterns established by the schedule of appearance of values could be built by placing the correct Munsell color sheet behind the appropriately cut-out rectangle and inserting them into the frame. Since three of the nine positions within the frame were used by the three cut-out rectangles with the appropriate color showing through, the other six positions were filled with blank rectangles. Colored 35 mm. photographs were taken of the 100 different stimulus patterns constructed in this fashion and mounted into 2 in. X 2 in. slides. These were the stimulus materials used in the experiment.

Preliminary Try-out

The 100 slides were assembled into 10 trial blocks of 10 trials each. Preliminary work with third grade children who were not used later as subjects in the experiment proper suggested that a stimulus exposure time of 5 seconds, inter-trial interval of 4 seconds, and an inter-trial block interval of 9 seconds was satisfactory. The total performance time for this task was almost 16 minutes which was thought to be well within the tolerance limits of third grade children for learning experiments of this type.

Instrumentation

The electronic apparatus used in this experiment was specially designed and consisted of four units interconnected by cables.

The first unit was a combination solid state programmer, timer, and memory storage device which controlled precisely all events occurring in the other three units.

Two modifications were made on a Sawyer "500"R projector for the second unit. One modification was a set of programmer impulse controlled gates mounted directly in front of the slide holder inside the projector to provide tachistoscopic control over stimulus exposure time. A second modification consisted of a bank of photo-electric cells installed on the slide holder. Cells in this bank could be activated by light from the projector bulb shining through notches on the edge of the stimulus slides. The placement of these notches on the edge of the stimulus slide dictated which photo-electric cell would provide an impulse to be "read" by the programming unit thereby controlling the reinforcing events for responses made by the subject as well as the time of stimulus events.

The third unit was a 2-1/2 in. X 15 in. X 24 in. response unit which had a 4 in. X 4 in. start plate mounted on the front center and two 2-1/4 in. X 2-1/4 in. X 3/4 in. white translucent plastic response elements (pushbuttons) mounted 16 in. apart at the back. The right-hand response element was the "concept present" button and the left-hand element was the "concept not-present" button. A frosted lucite screen 17 in. X 24 in. was mounted on the back of the response unit. Rear-view projection of the stimulus slides allowed the subject to view each slide before pressing one of the response elements.

If the red square was present and the subject pushed the right-hand response element, the programmer read a concept present notch on the slide in the projector and provided immediate reinforcement by impulsing an internal light source which lit up the button pressed. The response element stayed lighted for the duration of the stimulus exposure time. On the other hand, if the concept to be learned was present and the subject pressed the left-hand response element, no light reinforcement was given. In the same way, if the concept was not present and the subject pressed the left-hand response element, immediate light reinforcement was given, whereas, if the right-hand element was pressed, no reinforcement was given.

The fourth unit was an adding machine modified by attaching solenoids to the keyboard keys which could then be triggered by impulses from the programmer as a function of slide notches and subject response. For example, if the relevant concept were present and the subject pressed the right-hand response element, the programmer instructed the modified adding machine to print out a series of digits indicating the correct response, subject response, correctness of subject response, and the time taken to make the response (latency) in tenths of a second. The last slide of each trial block had a special notch which was read by the programmer and impulsed this unit to total the correct responses and speed of response during that trial block of 10 trials.

Task and Directions

The task was to learn to press the right-hand or concept present response element when the red square was projected on the screen and to press the left-hand or concept not-present element when the red square was not on the screen. Immediate light reinforcement was given when the correct response element was pressed for any given stimulus and not given when the incorrect element was pressed. Thus, the task consisted of pressing a button for each stimulus presented, obtaining information about the correctness of response from light or no-light reinforcement, and eventually learning to press the concept present button when the red square appeared on the screen and the concept not-present button when the red square did not appear on the screen.

Each triad was brought to the experimental setting and S1 was placed in front of the response unit with O1 and O2 on either side where they could view easily the stimuli and S1's performance.
The following instructions were given to the triad (instructions in capital letters):
(S1's name) STAND HERE AND PUT YOUR HAND HERE. (E points to start plate). (E looks at O1 and O2). NOW, YOUR JOB (O1 and O2's names) IS TO WATCH (S1's name) WHILE HE (SHE) PLAYS THE GAME. LISTEN CAREFULLY TO WHAT I TELL HIM (HER), WATCH THE PICTURES, AND BE SURE TO WATCH THE BUTTONS TO SEE WHEN THEY LIGHT UP. YOU WILL HAVE A CHANCE TO PLAY THE GAME LATER SO WHILE YOU'RE WATCHING TRY TO FIND OUT WHICH PICTURES MAKE THE BUTTONS LIGHT UP.

Then E gave the following concept formation instructions to S1:
WE ARE GOING TO PLAY A GAME WHERE YOU PUSH BUTTONS. THIS IS THE "RIGHT" BUTTON (E points to right button) AND THIS IS THE "WRONG" BUTTON (E points to left button). THIS IS THE WAY YOU PUSH THE BUTTONS. (E demonstrates from start plate to each of the buttons). NOW, YOU PUSH THE BUTTONS WHEN I TELL YOU. WATCH THE BUTTON LIGHT UP WHEN YOU PUSH IT. PUSH THE RIGHT BUTTON. PUSH THE WRONG BUTTON. RIGHT--RIGHT--WRONG--WRONG. DID YOU SEE THE BUTTONS LIGHT UP? GOOD! NOW, I AM GOING TO SHOW YOU SOME COLORED PICTURES WITH SQUARES ON THEM. I WANT YOU TO POINT AT THE COLORED SQUARE AS I SHOW YOU EACH PICTURE. (E shows slides No. 94, 95, 96, 97, 98, and 99). GOOD! NOTICE THAT THE SQUARES WERE IN DIFFERENT PLACES. SOMETIMES HERE (E points to left of screen), SOMETIMES HERE (E points to right of screen) AND SOMETIMES IN THE MIDDLE (E points to middle of screen). IT DOESN'T MATTER WHERE THE SQUARE IS. NOTICE THAT THE SQUARES WERE OF DIFFERENT COLORS. THERE IS ONE COLORED SQUARE THAT TELLS YOU WHETHER THE PICTURE IS RIGHT OR WRONG. IF THE PICTURE IS RIGHT ---- YOU PUSH THIS BUTTON AND IT WILL LIGHT UP LIKE THIS (E lights up right button briefly). IF THE PICTURE IS WRONG ---- YOU PUSH THIS BUTTON AND IT WILL LIGHT UP (E lights up left button briefly). IF THE BUTTON DOES NOT LIGHT UP IT MEANS YOU SHOULD HAVE PUSHED THE OTHER BUTTON. THE GAME IS TO LOOK AT THE SQUARE IN EACH PICTURE AND THEN PUSH A BUTTON AS FAST AS YOU CAN TO SEE IF THE BUTTON LIGHTS. IN THIS WAY YOU CAN FIND OUT WHICH ARE THE RIGHT PICTURES AND WHICH ARE THE WRONG PICTURES.

E quizzes S1 on his understanding of the task:

WHAT DO YOU LOOK FOR IN EACH PICTURE? (E corrects S1 if some variation of "colored square" is not given as an answer). WHAT DO YOU DO AFTER YOU LOOK AT THE COLORED SQUARE? (E corrects S1 if some variation of "push buttons" is not given as an answer). WHAT WILL YOU FIND OUT BY LOOKING AT THE PICTURES AND PUSHING BUTTONS? (E corrects S1 if some variation of "the buttons will light to show which are the right and which are the wrong pictures" is not given as an answer). GOOD! WE WILL PLAY THE GAME NOW. THE IDEA IS TO GET THE PUSHBUTTONS TO LIGHT UP. DO YOU HAVE ANY QUESTIONS? (E answers S as briefly as possible). REMEMBER TO FIND THE RIGHT AND WRONG PICTURES YOU LOOK AT COLORED SQUARES.

In order to keep the triad oriented to the proper cues, E says at the end of Trial Blocks 1, 2, 3, 4, and 5:
IT DOESN'T MATTER WHERE THE SQUARE IS. KEEP TRYING TO FIND THE COLORED SQUARES THAT MAKES THE BUTTON LIGHT.

The following instructions were given to O1 for concept formation and S1, O1, and O2 for the 24 hour concept retention test:

NOW, YOU'RE GOING TO PLAY THE SAME GAME. DO YOU REMEMBER HOW TO PLAY THE GAME? WHAT DO YOU LOOK FOR IN EACH PICTURE? (E corrects O1 if some variation of "colored square" is not given as an answer). WHAT DO YOU DO AFTER YOU LOOK AT THE COLORED SQUARE? (E corrects O1 if some variation of "push buttons" is not given as an answer). WHAT WILL YOU FIND OUT BY LOOKING AT THE PICTURES AND PUSHING BUTTONS? (E corrects O1 if some variation of "the button will light to show which are the right and which are the wrong pictures" is not given as an answer). GOOD! WE WILL PLAY THE GAME NOW. THE IDEA IS TO GET THE PUSHBUTTONS TO LIGHT UP. DO YOU HAVE ANY QUESTIONS? (E answers S as briefly as possible). REMEMBER, TO FIND THE RIGHT AND WRONG PICTURES YOU LOOK AT COLORED SQUARES.
The subjects were cautioned to attend to the task when necessary.

In general, these instructions were designed to imitate the teacher's role in classroom demonstrations where one or two children are used as performers to illustrate the concepts being taught. Thus, the directions explained the purpose of the learning task to all "pupils" in the miniature classroom (S1, O1, O2), oriented the performer (S1) and the observers (O1, O2), adapted the performing pupil (S1) to the learning materials (apparatus and stimulus materials), and gave supportive guidance in the form of directive cues while the "pupil" (S1) was performing.

ANALYSES OF DATA AND RESULTS

Subject Performance on Concept Formation and Retention Tasks

Subject performance in the form of correct responses made during concept formation and retention was the dependent variable used in the major analyses reported in this section. Specifically, the criterion was the correct number of responses out of 100 stimulus presentations rather than the usual trials to criterion since only 24 out of 60 subjects reached 100 percent criterion on the concept formation task. While the S1 subjects were given 100 stimulus presentations in blocks of 10 trials regardless of their performance on the concept formation task, 01 subjects who reached 100 percent performance on two successive trial blocks of 10 trials were stopped and extrapolated scores at the 100 percent level assigned for all succeeding trial blocks. Likewise, all subjects who reached the 100 percent performance level on two successive trial blocks during the retention test were stopped and extrapolated scores at the 100 percent level assigned for all succeeding trial blocks. Performance as a function of triad position was the main variable under investigation, however, sources of variance associated with sex and IQ level were also analyzed. In other words, major statistical comparisons were made of the performance of S1 and 01 on the concept formation task and S1, 01, and 02 on the concept retention task.

The performance of subjects in terms of the mean number of correct responses out of 100 trials on the concept formation and retention tasks as a function of triad position, sex, and IQ level is reported in Table 2. Since the concept learning and retention of subjects in various triad positions was the main variable under investigation, Figure 1 was prepared to show performance across concept formation and retention trials as a function of triad position. Reference to Table 2 and Figure 1 should facilitate an understanding of the statistical analyses which follow.

Table 2

Mean Number of Correct Subject Responses out of 100 for Concept Formation and Retention by Triad Position, Sex, and IQ Level

Triad Position	Sex	IQ Level	N	Concept Formation	Concept Retention
S1	Boys	High	5	66.0	76.2
		Medium	5	59.8	84.8
		Low	5	51.6	64.0
	Girls	High	5	62.2	73.0
		Medium	5	57.0	68.6
		Low	5	62.6	76.6
O1	Boys	High	5	76.6	90.6
		Medium	5	87.6	91.6
		Low	5	50.4	52.4
	Girls	High	5	77.2	90.4
		Medium	5	77.2	90.4
		Low	5	66.6	80.2
O2	Boys	High	5	----	83.8
		Medium	5	----	55.0
		Low	5	----	64.0
	Girls	High	5	----	77.8
		Medium	5	----	75.6
		Low	5	----	87.8

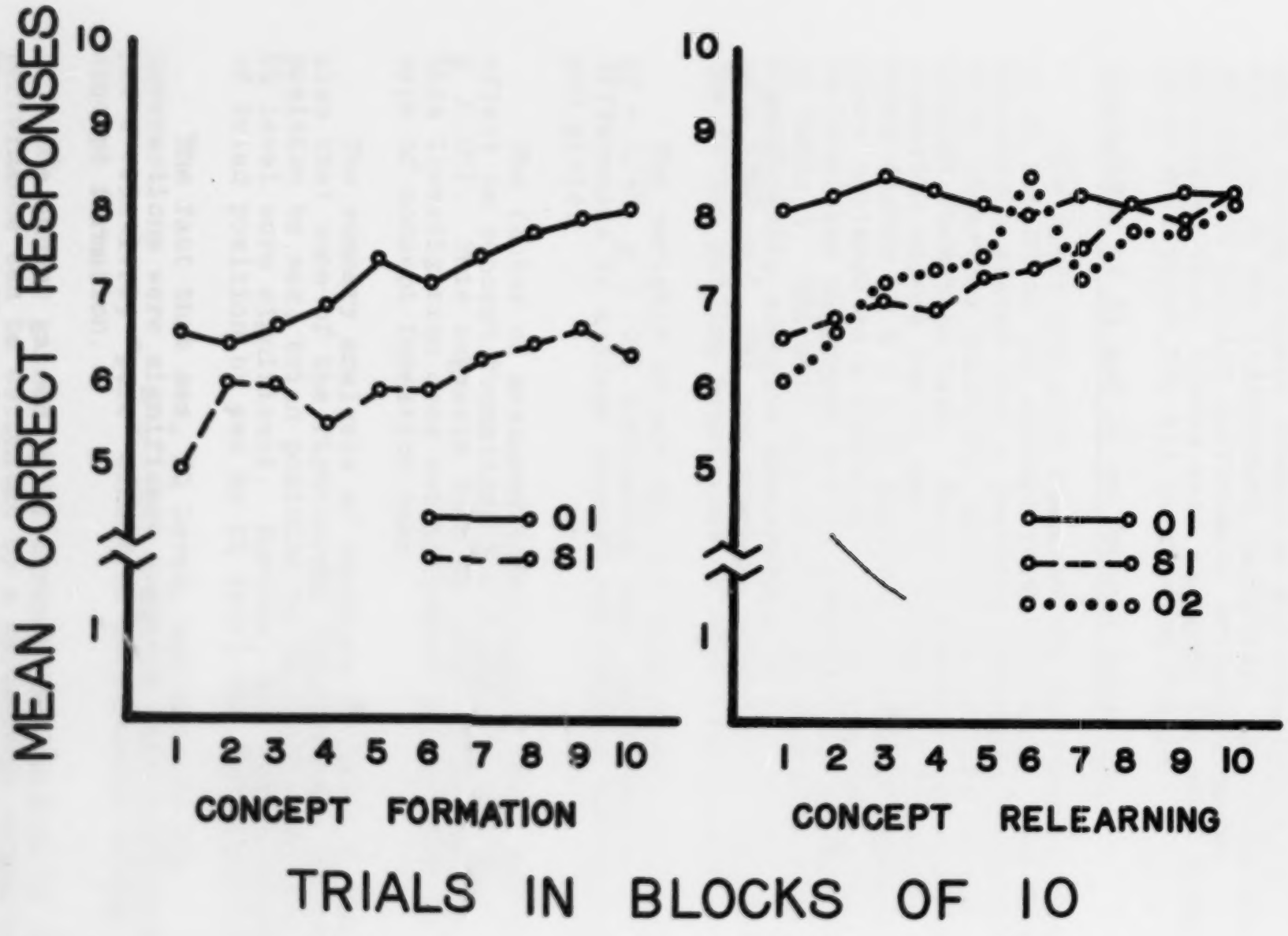


Fig. 1. Mean Number of Correct Concept Formation and Retention Responses in Trial Blocks of 10 as a Function of Triad Position

In addition, similar analyses of latency data provided minor but useful descriptions of performance speed during concept formation and retention as a function of the independent variables. Subjects who reached 100 percent performance criterion on two successive trial blocks were assigned the mean latency up to that point for all succeeding trials.

Comparison of S1 and O1 on Concept Formation

The first analysis compared the performance scores of S1 and O1 on the concept formation task. The original hypothesis stated that a learning advantage would accrue to an observing child who watched S1 perform on the concept formation task. Table 2 presents the mean concept formation scores for S1 and O1 by sex and IQ level. A three-factor (2 X 2 X 3) analysis of concept formation score variance as a function of triad position, sex, and IQ level was performed and is presented in summary form in Table 3. The main effect of triad position shows the significantly superior performance of O1 over S1 ($F = 6.645$, $df = 1/48$, $p < .05$) and provides statistical support for one of the guiding hypotheses of this investigation.

The variable of sex was not significant ($F = .133$, $df = 1/48$, $p > .05$) indicating that there were no differences in average concept acquisition between boys and girls.

The factor of measured intelligence level had little effect on concept formation ($F = 2.915$, $df = 2/48$, $p > .05$). This suggests that IQ level as defined in this investigation does not influence performance on this type of concept formation task.

The summary analysis of variance in Table 3 shows also that none of the first-order interactions of triad position by sex, triad position by IQ level, and sex by IQ level were significant. Further, the triple interaction of triad position by sex by IQ level was not significant.

The fact that sex, IQ level, and none of the interactions were significant suggests that triad position has a relatively "pure" effect on performance during concept formation.

The amount gained by O1 through observation of S1's performance can be estimated by a percentage comparison. Thus, average O1 performance was approximately 21.3 percent better than S1 on the concept formation task.

Table 3

Summary Analysis of Variance of Concept Formation Scores by Triad Position, Sex, and IQ Level

Sources	df	SS	MS	F
Triad Position (TP)	1	2432.067	2432.067	6.645*
Sex (S)	1	48.600	48.600	.133
IQ Level (IQ)	2	2133.734	1066.867	2.915
TP X S	1	1.667	1.667	.005
TP X IQ	2	1276.933	638.467	1.745
S X IQ	2	1106.800	553.400	1.512
TP X S X IQ	2	47.733	23.867	.065
Within-cells (w)	48	17567.200	365.983	
Total	59	24614.734	41.720	

* $p < .05$

Comparison of Concept Formation and Retention for S1 and O1

The statistical comparison of the performance of S1 and O1 was extended to cover concept formation and retention (relearning) scores as a function of triad position, sex, and IQ level by means of a mixed higher-order design. This analysis pooled concept formation and retention scores in order to obtain estimates of the effect of the three variables under study on learning and retention. The performance of O2 could not be considered in this analysis due to the absence of concept formation scores. Table 4 summarizes the analysis of pooled concept formation and retention score variance by triad position, sex, and IQ level. In addition, the variance attributable to performance differences in concept formation and retention was analyzed statistically as a within-subjects effect.

The superior performance of O1 over S1 was maintained when considering pooled concept formation and retention scores ($F = 4.844$, $df = 1/48$, $p < .05$).

The influence of sex on pooled concept formation and retention scores was not significant ($F = .270$, $df = 1/48$, $p > .05$) which is consistent with the findings of the first analysis.

A surprising finding, in view of the first analysis, was that combined concept formation and retention scores were influenced by IQ level ($F = 3.551$, $df = 2/48$, $p < .05$). Further, analyses of the simple effects showed that this result was due primarily to the significantly lower performance of the low IQ groups on the retention test.

None of the between-subjects first- and second-order interactions were significant which leaves triad position and IQ level as relatively "pure" between-subjects main effects.

Inspection of the within-subjects source of variance shows that concept retention was significantly superior to concept formation ($F = 40.831$, $df = 1/48$, $p < .001$). This was not surprising since the retention test was conducted under relearning conditions identical to the concept formation procedure and improvement would be expected. However, it was surprising to find that none of the within-subjects first- or higher-order interactions was significant. It is not unusual to find significant interactions when this many variables are combined into a statistical analysis of performance on a learning task.

Table 4

Summary Analysis of Variance of Concept Formation and Retention Scores by Triad Position, Sex, and IQ Level

Sources	df	SS	MS	F
Between-Ss	59	48857.467		
Triad Position (TP)	1	3456.134	3456.134	4.844*
Sex (S)	1	192.534	192.534	.270
IQ Level (IQ)	2	5067.217	2533.609	3.551*
TP X S	1	258.132	258.132	.362
TP X IQ	2	2287.216	1143.608	1.603
S X IQ	2	3276.016	1638.008	2.296
TP X S X IQ	2	70.418	35.209	.050
error (b)	48	34249.800	713.538	
Within-Ss	60	10262.000		
Learning-Retention (LR)	1	4320.000	4320.000	40.831****
LR X TP	1	120.000	120.000	1.138
LR X S	1	16.133	16.133	.153
LR X IQ	2	43.550	21.775	.206
LR X TP X S	1	361.201	361.201	3.424
LR X TP X IQ	2	212.150	106.075	1.006
LR X S X IQ	2	103.817	51.909	.492
LR X TP X S X IQ	2	21.749	10.875	.103
error (w)	48	5063.400	105.488	
Total	119	59119.467		

**** $p \leq .001$
* $p < .05$

Concept Retention: Comparison of S1, O1, and O2 under Relearning Procedures

The previous analysis compared the performance of O1 and S1 in order to obtain estimates of the effect of triad position on pooled concept formation and retention scores, whereas this particular analysis compared the relearning of S1 and O1 with the performance of an observer (O2) who performed only on the 24 hour retention test. The three-factor summary analysis of concept retention score variance is presented in Table 5. None of the main effects were significant in this analysis. It should be remembered that the concept retention task was run as a relearning procedure and the analysis was based on mean performance scores, therefore, relearning reduced between-triad position differences to produce this result. This is most clearly illustrated by Figure 1 where the initial performance differences on Trial Block 1 which are analyzed in the following section had disappeared by Trial Block 10. Ordinarily, such a finding would preclude a test of the simple effects, however, one of the hypotheses stated that the relearning performance of S1 and O1 would be superior to O2 who performed only on the retention task. Analyses of the simple effects using the within-cells source of variation as the error term showed that the performance of O1 was significantly superior to that of S1 ($t = 2.275$, $df = 72$, $p < .05$) and O2 ($t = 2.240$, $df = 72$, $p < .05$) but that there was no significant difference between the performance of S1 and O2 ($t = .346$, $df = 72$, $p > .05$). This provides further support for the guiding hypotheses even though such post hoc statistical analyses of this sort are equivocal when the main effect is not significant.

Concept Retention: Analyses of Recall Scores

In order to obtain further estimates of 24 hour retention differences as a function of triad position, an analysis comparing the performance of S1 and O1 on Trial Block 10 of the concept formation task and the comparative performance of these two subjects with O2 in Trial Block 1 of the retention test was performed. Table 6 presents the mean performance scores on Trial Block 10 of the concept formation task for S1 and O1 and summarizes the simple analysis of concept score variance on this trial block. This analysis supports the findings of the previous analysis reported in Table 3 and shows that the performance of O1 is significantly superior to S1 ($F = 7.728$, $df = 1/58$, $p < .01$).

Table 5

Summary Analysis of Variance of Concept Retention Scores by Triad Position, Sex, and IQ Level

Sources	df	SS	MS	F
Triad Position (TP)	2	1502.289	751.145	1.699
Sex (S)	1	934.444	934.444	2.114
IQ Level (IQ)	2	1891.356	945.678	2.140
TP X S	2	913.890	456.945	1.034
TP X IQ	4	3563.711	890.928	2.016
S X IQ	2	2582.423	1291.212	2.921
TP X S X IQ	4	1150.643	287.661	.651
Within-cells (w)	72	31822.400	441.978	
Total	89	44361.156		

Table 6

Means, Standard Deviations, and Summary Analysis of Variance of Concept Formation Scores on Trial Block 10 as a Function of Triad Position

	N	M	σ
S1	30	6.333	2.358
O1	30	8.100	2.481

Sources	df	SS	MS	F
Triad Position	1	46.816	46.816	7.728**
Within-groups (w)	58	351.367	6.058	
Total	59	398.183		

** $p < .01$

Table 7 presents the mean recall scores of S1, O1, and O2 on Trial Block 1 of concept relearning as well as the summary of the simple analysis of concept recall variance on this trial block. The effect of triad position on recall was significant ($F = 4.768$, $df = 2/87$, $p < .05$). Analyses of the simple effects using the within-groups source of variation as the error term shows that the recall of O1 was significantly superior to that of S1 ($t = 2.206$, $df = 87$, $p < .05$) and O2 ($t = 2.976$, $df = 87$, $p < .01$) but that S1 did not differ significantly from O2 even though the mean difference was in the predicted direction.

Speed of Response: Analyses of Latencies

The speed of response (latency) to the stimulus materials used in this experiment was defined as the time from stimulus (slide) onset until the subject responded by pressing one of the two response elements or until the stimulus exposure time of 5 seconds ran out. Comprehensive analyses of variance of latencies on the concept formation and retention tasks were computed separately using mixed higher-order statistical designs. In addition, a mixed higher-order analysis of variance on the concept formation and retention scores for S1 and O1 was carried out in order to obtain estimates of response speed change between concept learning and retention.

The summary analysis of variance of latencies (S1 versus O1) during concept formation by triad position, sex, and IQ level is reported in Table 8. The mean response speed of 1.610 seconds for O1 was significantly faster than the 1.813 seconds for S1 ($F = 4.717$, $df = 1/48$, $p < .05$). Table 8 also indicates that boys ($\bar{X} = 1.608$ seconds) had a significantly faster mean response speed ($F = 4.848$, $df = 1/48$, $p < .05$) than girls ($\bar{X} = 1.814$ seconds). The finding of significant sex differences in latencies was due primarily to the slower response speeds of the S1 girls. None of the between-subjects interactions were significant. A significant decrease in response speed within-subjects across concept formation trials was obtained ($F = 2.103$, $df = 9/432$, $p < .05$). A significant trials by triad position within-subjects interaction was found ($F = 4.833$, $df = 9/432$, $p < .001$) which is interpreted to mean that the latency curves obtained were not parallel. In general, average response speeds were slightly faster toward the end of the task, however, this result was due to the slower initial performance of the S1 girls.

Table 7

Means, Standard Deviations, and Summary Analysis of Variance of Recall Scores on Trial Block 1 of Concept Retention as a Function of Triad Position

	N	M	σ
S1	30	6.567	2.275
O1	30	8.000	2.556
O2	30	6.067	2.581

Sources	df	SS	MS	F
Triad Position	2	60.423	30.212	4.768*
Within-groups (w)	87	551.233	6.336	
Total	89	611.656		

* $p < .05$

Table 8

Summary Analysis of Variance of Concept Formation Latencies by Triad Position, Sex, and IQ Level

Sources	df	SS	MS	F
Between-Ss	59	83.562		
Triad Position (TP)	1	6.194	6.194	4.717*
Sex	1	6.366	6.366	4.848*
IQ	2	.052	.026	.019
TP X Sex	1	3.416	3.416	2.602
TP X IQ	2	.331	.166	.126
Sex X IQ	2	3.573	1.787	1.361
TP X Sex X IQ	2	.585	.293	.223
error (w)	48	63.045	1.313	
Within-Ss	540	45.715		
Trials	9	1.475	.164	2.103*
Trials X TP	9	3.392	.377	4.833****
Trials X Sex	9	.837	.093	1.192
Trials X IQ	18	.885	.049	.628
Trials X TP X Sex	9	.821	.091	1.167
Trials X TP X IQ	18	2.126	.118	1.513
Trials X Sex X IQ	18	1.352	.075	.962
Trials X TP X Sex X IQ	18	1.132	.063	.808
error (w)	432	33.695	.078	
Total	599	129.277		

**** $p \leq .001$
* $p < .05$

The summary analysis of concept retention latencies for S1, O1, and O2 is presented in Table 9. None of the between- or within-subject main effects were significant. A significant between-subjects sex by IQ level interaction was obtained ($F = 3.347$, $df = 2/72$, $p < .05$), however, inspection of the latency interaction table indicated irregular and overlapping trends.

A mixed higher-order analysis of variance of latencies for S1 and O1 was computed in order to obtain statistical estimates of amount of response speed change between concept formation and retention. A summary of this analysis is not presented in tabular form since none of the between- and within-subjects main or first- and second-order interaction effects were significant. The mean latency for concept formation was 1.711 seconds and 1.703 seconds for concept retention which was not significantly different.

Table 9

Summary Analysis of Variance of Concept Retention Latencies by Triad Position, Sex, and IQ Level

Sources	df	SS	MS	F
Between-Ss	89	204.934		
Triad Position (TP)	2	3.840	1.920	.822
Sex	1	3.906	3.906	1.671
IQ Level	2	2.677	1.334	.571
TP X Sex	2	3.130	1.565	.670
TP X IQ	4	2.451	.613	.262
Sex X IQ	2	15.646	7.823	3.347*
TP X Sex X IQ	4	5.011	1.253	.536
error (b)	72	168.273	2.337	
Within-Ss	810	47.412		
Trials (T)	9	.583	.065	1.121
T X TP	18	.883	.049	.845
T X Sex	9	.615	.068	1.172
T X IQ	18	1.255	.070	1.207
T X TP X Sex	18	1.820	.101	1.741
T X TP X IQ	36	2.833	.079	1.362
T X Sex X IQ	18	.935	.052	.897
T X TP X Sex X IQ	36	1.121	.031	.534
error (w)	648	37.367	.058	
Total	899	252.346		

* $p < .05$

CONCLUSIONS AND IMPLICATIONS

This section will be devoted to a summary and discussion of the research findings under the headings of research strategy, technology and classroom learning, and observational learning. Implications for practical applications and for further research will be included where appropriate in the discussion and not under a separate heading.

Research Strategy

At least two major problems complicate the study of classroom learning. The problem of greatest significance is the lack of a comprehensive educational process theory which provides research directives in the form of testable hypotheses. The other problem, not so difficult to handle now that multivariate methods are readily available, is the large number of variables which singly or in interaction influence the group learning process. These two points have been considered carefully in designing the strategy of this project. The strategy which was developed is not completely novel but has some unique points which merit consideration for future educational process research.

Only a brief study of classroom learning processes is necessary to provide an idea of the range and scope of the dynamics involved. The literature is replete with a number of highly creative and unique studies designed to analyze or control these processes. However, most of these studies are not hooked to theoretical formulations and have to stand alone without the support of the interlocking relationships and testable ideas that theory provides. Of course, selecting the point of research attack on problems of classroom learning is up to the investigator and this project was no exception. A careful consideration of classroom learning suggested two main points of attack which guided the development of the research strategy used in this experiment. The question of what is learned in the classroom was answered in a very general way to provide the first point. What is learned is the organization of knowledge and the formation and development of concepts are basic cognitive processes underlying classroom learning. The acquisition and use of concepts and knowledge organizers

are significant educational goals and almost any classroom learning sequence can be separated into one or more parts which fall in this category. It seemed appropriate to use a concept learning task based on previous research findings to tap this process. The second point of attack was derived from the notion that social learning and imitation are basic to the educational process. The fact that children learn through observation in a social setting is commonly accepted but the application of research techniques and ideas from this social-psychological area to educational processes needs to be extended. The use of these two points of attack is especially important since both concept formation and social learning and imitation are linked historically to theoretical learning formulations which have been well defined by extensive empirical tests.

It is well known that the behavioral scientist prefers the controlled environment of the laboratory to isolate a single variable from the influence of extraneous variables operating in the naturalistic setting. The research strategy followed this idea by using simulation procedures with a miniature classroom of three children, an electronic teaching device, and an experimenter to provide laboratory-like conditions for studying the observational learning of concepts.

The research strategy could be summarized as:
1. The selection of those aspects of the educational process within classrooms which are related to presently well-defined theories with empirical backing, namely, concept formation and social learning and imitation.
2. The study of one major variable to demonstrate its effect, namely, observational learning or more specifically concept formation and retention as a function of triad position.
3. The use of simulation procedures to provide laboratory conditions for controlling extraneous variables in the classroom setting.

Technology and Classroom Learning

Present advances in technology are being applied at an ever increasing rate to educational problems. Teaching machines, programmed learning, electronic laboratories, and exceptional advances in the use of exotic audio-visual equipment are contributing significantly to educational practice. The state of the art is difficult to describe because of its rapid acceptance by modern educators. Many electronic tools, especially those developed for automated instruction,will become increasingly useful in research applications for studying signifiant educational processes.

This technological development makes it extremely feasible for American educators and psychologists to extend their knowledge of classroom learning experiments by more careful and precise investigations using simulation techniques.

In this experiment, a miniature classroom of three subjects (one performer and two observers) learned a general concept from an electronic teaching device. Advances in solid state circuitry made it possible to devise a completely portable and fairly reliable apparatus which simulated classroom conditions with a high degree of control over extraneous variables. The advantages of taking the laboratory to the subjects rather than the subjects to the laboratory are obvious when investigative effort centers on the public school child. In fact, future research designed to study the educational process would be well advised to take advantage of the economy of simulation procedures using portable electronic apparatus.

Observational Learning

The results of this experiment were most encouraging in view of the stated research aims and hypotheses. One of the guiding hypotheses for this project was that the child who observes the performance of another child on a concept formation task has a marked and significant advantage when performing later on the same task. This effect was clearly demonstrated with the concept learning of the observing child significantly superior to the child who acted as the performer. The amount "gained" by the observer was approximately 22 percent. Further, the effect was relatively "pure" since neither sex nor IQ level nor the interaction of these variables with triad position were significant.

The effect of triad position on concept retention 24 hours later was in the predicted direction with one qualification. It was predicted that O1 would be superior to S1 on concept retention and this was supported. Further, it was predicted that S1 would be superior to O2 on retention but this was not borne out. In general, these results were obtained for both recall and relearning retention estimates. The retention hypotheses were only partially supported even though the significant differences between observer (O1) and performer (S1) were maintained during concept retention. It was of interest to note that the performance across learning trials of the observer

who performed only on the concept retention task (O2) was highly similar to that of the observer who performed on the concept formation task (O1). Graphical evidence (see Figure 1) indicated that the average performance of the performer (S1) and the two observers (O1, O2) on the last trial block of concept retention did not differ significantly. This may be of considerable practical importance since it suggests that children who must wait 24 hours to demonstrate concepts learned through observation can do so if given sufficient time.

It was shown that neither sex nor IQ level as defined in the experimental procedures exerted a significant effect on concept formation and retention. Since these factors are usually presumed to have some influence on classroom learning, it is encouraging to note that concept learning through observation was little effected by these variables. This suggests that the cognitive processes, of which concept formation is one, are not influenced by some classroom variables usually considered important. There was one qualification. It was found that when concept formation and retention scores were pooled the low IQ levels were significantly lower in average performance. This may be an important variable when duration of retention is systematically varied as part of the experimental design and should be investigated further.

It is of empirical interest to note that boys responded significantly faster than girls to the concept formation stimulus materials. This was due primarily to the longer latencies of the S1 girls. Also it was found that O1 subjects responded significantly faster on the average than S1 subjects. No differences were obtained for concept retention latencies. This provides support for the notion that children who acted as observers in the miniature classroom responded significantly faster. Future research on the motivational properties of observational settings could be studied fruitfully.

Appendix A

Dear Third Grade Parent:

The Cedar Rapids Community School District is conducting a study concerned with the way children learn and retain concepts. This project is supported by the U.S. Office of Education and will involve third grade children. Each child will have an opportunity to look at attractively colored slides of geometric shapes and select the correct one by pressing pushbuttons to give the answer. From past experience with these materials, the children enjoy participating in this game very much.

The project should give us some important information about the way children learn concepts through observation. It would be appreciated greatly if your child is allowed to participate. Kindly sign this letter at the appropriate spot at the bottom indicating whether you would like to have your child participate and then have your child return it to the school.

Sincerely,

Ira J. Semler, Ph.D.
Director of Research
Cedar Rapids Community
School District

I want my child to participate_____
(Parent's Signature)

I do not want my child to participate_____
(Parent's Signature)

Appendix B

Schedule of Appearance of Values

Code: Color Code: R - Red
G - Green
Blu - Blue
Y - Yellow
Blk - Black
W - White

Size Code: L - Large
S - Small

Position Code:

7	3	6
4	1	2
8	5	9

\+ = positive instances (appearance of red square)

Trial Block	Stimulus Number	Square			Circle			Triangle		
		Size	Color	Position	Size	Color	Position	Size	Color	Position
1	1	S	W	4	L	R	6	S	Y	5
1	2	S	Y	6	L	R	1	S	G	5
1	3	S	+R	9	S	G	4	L	W	6
1	4	L	+R	1	S	Y	6	L	G	8
1	5	S	+R	2	L	Blu	4	L	Blk	9
1	6	L	+R	6	S	Blk	4	S	W	8
1	7	S	G	3	S	Y	7	L	Blu	4
1	8	L	Blu	8	S	G	1	L	Blk	4
1	9	S	+R	4	L	W	6	S	Y	5
1	10	L	Blk	7	L	Blu	6	L	W	4
2	11	S	Y	4	L	R	2	S	Blu	1
2	12	L	+R	5	L	G	9	L	Blk	3
2	13	S	+R	7	L	G	5	S	Blu	2
2	14	S	W	6	S	Blk	4	S	Y	1
2	15	L	+R	7	S	Y	3	L	Blu	2
2	16	S	+R	9	L	Blk	6	S	Y	1
2	17	S	Blu	3	S	G	1	S	W	7
2	18	L	Blk	6	S	Blu	9	S	R	8
2	19	L	G	1	S	Y	8	S	Blk	9
2	20	S	+R	9	L	W	7	L	G	6

Appendix B

Schedule of Appearance of Values

Trial Block	Stimulus Number	Square			Circle			Triangle		
		Size	Color	Position	Size	Color	Position	Size	Color	Position
3	21	S	Y	6	L	R	1	S	G	5
3	22	S	+R	9	S	G	4	L	W	6
3	23	L	Blk	4	S	Blu	5	L	Y	2
3	24	S	+R	2	L	Y	7	L	Blk	8
3	25	L	W	7	L	Blk	3	L	G	1
3	26	S	G	1	S	Y	2	L	W	4
3	27	S	+R	5	L	Blk	3	S	G	1
3	28	L	+R	6	L	Blu	4	S	Y	1
3	29	L	Blu	8	S	G	4	L	R	1
3	30	L	+R	1	S	W	7	S	Blu	8
4	31	S	+R	4	S	Y	5	L	W	6
4	32	L	+R	7	L	Blu	9	S	G	4
4	33	S	+R	6	S	W	1	L	Blk	2
4	34	L	Blu	5	S	G	2	S	Y	9
4	35	S	G	5	L	Y	3	L	R	1
4	36	S	W	5	S	Blk	9	S	Blu	1
4	37	S	+R	3	L	G	8	S	Y	9
4	38	S	+R	9	S	Blk	1	S	Blu	5
4	39	L	Y	5	S	R	3	L	W	4
4	40	L	Blk	6	L	Blu	1	S	G	3
5	41	S	Y	4	L	R	2	S	Blu	1
5	42	S	+R	4	L	W	6	S	Y	5
5	43	L	+R	6	S	Blk	4	S	W	8
5	44	L	G	1	S	Y	8	S	Blk	9
5	45	L	Blk	6	S	Blu	9	S	R	8
5	46	S	W	6	S	Blk	4	S	Y	1
5	47	L	+R	1	S	Y	6	L	G	8
5	48	S	+R	7	L	G	5	S	Blu	2
5	49	S	+R	2	L	Blu	4	L	Blk	9
5	50	S	Blu	3	S	G	1	S	W	7

Appendix B

Schedule of Appearance of Values

Trial Block	Stimulus Number	Square			Circle			Triangle		
		Size	Color	Position	Size	Color	Position	Size	Color	Position
6	51	L	Blu	8	S	G	4	L	R	1
6	52	S	Y	6	L	R	1	S	G	5
6	53	L	W	7	L	Blk	3	L	G	1
6	54	L	+R	7	S	Y	3	L	Blu	2
6	55	L	Blk	4	S	Blu	5	L	Y	2
6	56	S	G	1	S	Y	2	L	W	4
6	57	S	+R	9	L	W	7	L	G	6
6	58	L	+R	5	L	G	9	L	Blk	3
6	59	S	+R	7	L	G	5	S	Blu	2
6	60	S	+R	9	L	Blk	6	S	Y	1
7	61	L	Blu	5	S	G	2	S	Y	9
7	62	S	+R	5	L	Blk	3	S	G	1
7	63	L	Y	5	S	R	3	L	W	4
7	64	L	+R	7	L	Blu	9	S	G	4
7	65	S	G	5	L	Y	3	L	R	1
7	66	L	+R	6	L	Blu	4	S	Y	1
7	67	L	+R	1	S	W	7	S	Blu	8
7	68	L	Blk	4	S	Blu	5	L	Y	2
7	69	S	W	5	S	Blk	9	S	Blu	1
7	70	S	+R	2	L	Y	7	L	Blk	8
8	71	L	+R	7	L	Blu	9	S	G	4
8	72	S	G	3	S	Y	7	L	Blu	4
8	73	L	Blk	7	L	Blu	6	L	W	4
8	74	S	Y	6	L	R	1	S	G	5
8	75	S	+R	6	S	W	1	L	Blk	2
8	76	S	+R	3	L	G	8	S	Y	9
8	77	S	+R	9	S	Blk	1	S	Blu	5
8	78	L	Blu	8	S	G	1	L	Blk	4
8	79	S	+R	4	S	Y	5	L	W	6
8	80	S	W	4	L	R	6	S	Y	5

Appendix B

Schedule of Appearance of Values

Trial Block	Stimulus Number	Square			Circle			Triangle		
		Size	Color	Position	Size	Color	Position	Size	Color	Position
9	81	S	+R	2	L	Blu	4	L	Blk	9
9	82	S	G	1	S	Y	2	L	W	4
9	83	L	Blk	4	S	Blu	5	L	Y	[illegible]
9	84	L	+R	6	S	Blk	4	S	W	8
9	85	L	+R	1	S	Y	6	L	G	8
9	86	S	+R	7	L	G	5	S	Blu	2
9	87	S	Y	6	L	R	1	S	G	5
9	88	L	W	7	L	Blk	3	L	G	1
9	89	S	+R	4	L	W	6	S	Y	5
9	90	L	Blu	8	S	G	4	L	R	1
10	91	L	Y	5	S	R	3	L	W	4
10	92	L	+R	5	L	G	9	L	Blk	3
10	93	S	+R	9	L	Blk	6	S	Y	1
10	94	S	G	5	L	Y	3	L	R	1
10	95	L	+R	7	S	Y	3	L	Blu	2
10	96	S	W	5	S	Blk	9	S	Blu	1
10	97	S	+R	7	L	G	5	S	Blu	2
10	98	L	Blu	5	S	G	2	S	Y	9
10	99	L	Blk	6	L	Blu	1	S	G	3
10	100	S	+R	9	L	W	7	L	G	6